CHAPTER 1

INTRODUCTION

1-1 BACKGROUND

Designers, installers, and operation and maintenance (O&M) staff have struggled with the complexities and incompatibilities of multi-vendor building automation and control systems (often referred to as Direct Digital Control (DDC) systems) almost since they were introduced in the 1980's. DDC systems are routinely designed and procured on a building-by-building or sub-system by sub-system basis, most notably for heating, ventilating, and air-conditioning (HVAC) systems. Government procurement rules, which require competitive bidding make it extremely difficult if not impossible to procure new DDC systems compatible with existing ones. In the absence of sole-source procurement, new but incompatible DDC systems result at best in inefficiencies and at worst in complex and non-functioning systems. This is a problem with system-to-system data sharing, but more importantly where individual systems need to communicate with a supervisory monitoring and control (front-end) workstation such as in a basewide application. This inability to interoperate is a result of closed systems due to vendor-specific proprietary elements.

In contrast, open DDC systems are now available. An open DDC system is characterized by the ability for any qualified entity to readily modify, operate, upgrade, and perform retrofits on the DDC system. An open system:

- Permits multiple devices from multiple vendors to readily exchange information.
- Provides the capability to easily replace any device with another device procured from multiple sources.
- May have proprietary components within devices, but these proprietary components must be a small percentage of the overall device.
- May have fees associated with use of certain components.

Open communications and data sharing between multi-vendor systems is necessary to achieve effective system operation. Some of the benefits and capabilities of multi-vendor DDC systems that openly communicate include:

- Competitive procurement, most notably at the building and sub-system level.
- An operator workstation/user interface that provides for the same look and feel for monitoring and control regardless of which vendor's DDC system or sub-system an operator is viewing. As a result, system operators need only become proficient with one user interface.
- An operator workstation/user interface (software) that provides for management of base-wide system operations such as; remote alarm reporting; remote scheduling (on/off control), remote set point override, data logging and reports, energy management including load shedding, utilities monitoring/measurement for the purpose of monitoring energy performance contracts, and initial diagnosis of service calls. As a result, through a single user interface, system operators and managers are afforded the means to efficiently and effectively manage base-wide operations.

- Whole-building approach to systems integration. This includes the efficient inter-connection of HVAC control sub-systems. For example, terminal unit equipment, such as VAV boxes can be readily interfaced to the servicing air handler to provide a call for cooling. In addition, the whole-building approach provides the capability for integrating non-HVAC sub-systems such as fire and security
- Lays the groundwork for establishment of a non-proprietary and openly accessible 'point-database' in support of communications-network management requirements. The open database approach further insulates the government from the possibility of vendor lock-in and resulting proprietary procurement.

1-2 PURPOSE

This UFC is intended to be used with UFGS-15951 (Direct Digital Control for HVAC and Other Building Systems). The design concept described in this UFC provides definitive guidance intended to streamline DDC system design and installation leading to maintainable, interoperable, extensible, and non-proprietary control systems. The purpose of this UFC is two-fold;

- Describe a definitive methodology for the design of typical building-level control systems and strategies (primarily for HVAC) where the intent is to achieve at least a degree of commonality in systems designed and procured through different channels, and
- Describe a definitive methodology to obtain open systems, that can communicate and interoperate with each other and with a UMCS, through the use of an open communications protocol

The open systems approach described in this UFC is based on ANSI/EIA standard 709.1 communications protocol (sometimes referred to as LonTalk®) and on LONWORKS® Network Services (LNS™) network operating system. The standard protocol supports open communications while LNS supports open network management.

In this UFC the term LONWORKS® is used to loosely describe a collection of technologies (including hardware, and software), vendors and installers relating to or based on the ANSI-709 communications protocol.

1-3 SCOPE

1-3.1 HVAC control.

This UFC provides open systems DDC guidance for the design of heating, ventilating and air conditioning (HVAC) control systems and other building-level systems, sub-systems and equipment including: primary (air and water) built-up systems, terminal units, packaged equipment, and supervisory monitoring and control interface requirements for chillers and boilers. Control system architecture.

1-3.2 **Building control network.**

This UFC describes building control network communications including data exchange, architecture, and cabling in support of open communications between multiple-vendor building-level DDC systems. While the control system contractor will be required to define the cabling network in accordance with UFGS-15951 requirements (and submit a riser diagram), the designer must select data exchange parameters and have a degree of familiarity with network intent and requirements.

1-3.3 **UMCS interface.**

The DDC system can function as a stand-alone system but is intended to be integrated with a Utility Monitoring and Control System (UMCS) in accordance with the UMCS guidance (UFC 3-400-02 and UFGS-13801). Therefore, this UFC is intended to be used in coordination with UMCS UFC 3-400-02 and UFGS-13801 to provide for (usually remote) supervisory monitoring and control s part of a base-wide interface with the building-level control systems described in this UFC. This UFC (3-400-01) and UFGS-15951 helps to ensure that the building-level control system is capable of being interconnected with a UMCS. Even in the absence of a UMCS, this UFC describes the methodology for designer selection and specification of data exchange parameters including requirements that will facilitate subsequent non-proprietary UMCS interface (in the event the DDC system will not be interfaced to a UMCS as part of or in addition to the current project).

1-3.4 **Other systems.**

Although not directly addressed in the UFC or UFGS the methodology, approach, and many of the requirements defined in this UFC (and UFGS-15951) can be used to design other (non-HVAC) building-level open DDC systems such as water and sanitary sewer systems, electrical systems, lighting, and other utility systems and equipment.

1-4 **IMPLEMENTATION**

1-4.1 **Policy.**

This UFC pertains to new construction, addition, renovation, and retrofit projects. This UFC does not prohibit selection of system types not included herein. At the discretion of and with approval from the assigning government agency (such as the responsible Corps District), the design of the control systems may deviate from the standards defined in this UFC.

1-4.2 **Control system designer responsibilities.**

Project-specific implementation steps are described in the Project Implementation Chapter. The control system designer will be responsible for specifying each control system required for the project systems, and will incorporate the control loops, and control system sequences of operation, using the symbols, abbreviations, and acronyms designated in this guidance. This design responsibility requires producing a contract package that includes a specification, and a set of drawings for each control system. While many implementation details of will be left to the controls vendor, the designer will not depend on any control system vendor for the preparation of the contract package.

The design of an open system is not simple. It requires attention to great deal of detail. The specifications and accompanying drawings were developed to minimize the time and effort required on the part of the designer. Much of the necessary detail has been attended to during the development of this UFGS and UFC criteria. Still, project specific requirements must be addressed by the designer and the specifications and drawings edited accordingly. This includes, but is not limited to, editing the Points Schedule drawing which shows critical open system requirements. Some applications also require designer selection of hardware requirements, such as valve sizing and the selection of electric or pneumatic actuation.

Designs must be accomplished in accordance with the customer's specific requirements such as, in the case of a Corps of Engineers project, the Installation Design Guide (IDG) and the UMCS/DDC Master Plan (if/when these documents exist). To help obtain maximum benefit of interoperable DDC systems, designers should encourage their customers to develop a UMCS/DDC Master Plan as described in UFC 3-400-02.

1-4.3 **Control system vendor compliance.**

The specification will require the control system contractor to produce shop drawings, schedules, instructions, test plans, test procedures, testing procedures, and other documents showing the application of products to implement the control system design. The specification will require the contractor to implement the building-level ANSI-709.1 communications network in a manner that is consistent with performance requirements defined in the specifications. The specification will further require that the contractor perform calibration, adjustments, and testing of the control system and document the testing to show that the control system functions as designed.

1-5 **PROCUREMENT OPTIONS.**

1-5.1 **Non-proprietary procurement**

This approach is preferred and includes the use of LNS-based LonWorks® compatible with UMCS as described in this UFC and as specified in UFGS-15951.

1-5.2 **Proprietary procurement**

Approaches other than LNS-based LonWorks® described in this UFC may require proprietary procurement which is discouraged. Possible proprietary procurement options include:

- Develop a five-year requirements contract.
- Develop contract documents for an open system, but indicate in the contract that in lieu of an open system the contractor may provide a proprietary DDC system compatible with the existing base-wide system. This requires two designs and two specifications.
- Develop a contract specification for a control system that is strictly "local" with no need to interface to a supervisory system. This approach is strongly discouraged for two reasons:
    - It results in a system which cannot easily be integrated later into a basewide UMCS

- Except for the most trivial control systems, a system without a supervisory front end will generally not meet the customer needs for monitoring and control. What generally happens in this case is that the installation wants a front-end interface and the designer would be well advised to provide a front-end based on UFGS-13801